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ABSTRACT

Concerned with clarifying some of the more complex issues in drug abuse, the National Clearinghouse for Drug Abuse Information has prepared this special report on cocaine. Background information is provided through a summary of its history, legal status, and the opinions of authorities in the field. Significant research on the subject is presented together with major findings on various aspects of the problem. The pharmacology, chemistry, clinical effects (physiological, psychological, and behavioral), treatment, and patterns of use of the drug are dealt with. Bibliographic references are also listed. (BL)

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NATIONAL CLEARINGHOUSE FOR DRUG ABUSE INFORMATION

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The National Clearinghouse for Drug Abuse Information Report Series 11 through 18 are concerned with clarifying some of the more complex issues in drug abuse by gathering the significant research on each subject and summarizing the major findings on various aspects of the problem. They deal with the pharmacology, chemistry, clinical effects, treatment and the patterns of use of each drug and provide a background in the area by outlining the history, legal status and the opinions of authorities in the field. These fact sheets were prepared in part by the Student Association for the Study of Hallucinogens (STASH), Beloit, Wisconsin, under Contract No. HSM-42-71-26.

COCAINE

Introduction and History

The history of cocaine had its beginnings in an ancient Indian legend, which recounts how the children of the sun had been presented with the coca bush on the occasion of the formation of the Inca empire. In appreciation of this gift, which "satisfied the hungry, provided the weary and fainting with new vigour, and caused the unhappy to forget their miseries," the Inca priesthood attributed to the plant a divine status, placed the coca leaf on the royal emblem and named the first Inca queen "Mama Cuca."

From the advent of the Incas until a few centuries before Pizarro's conquest, the custody and use of the coca plant remained in the hands of the political and religious rulers. At that time the highest form of

SE 013 442

noble largesse was the bestowing of a small quantity of coca leaves upon a trusted lieutenant or aide. With the increasing complexities which developed in the Inca civilization, however, the use of coca leaves gradually seeped down to the common laborers, messengers and soldiers.

These common folk chewed coca leaves primarily for enjoyment and for the alleviation of symptoms of fatigue. Long periods of strenuous labor and long distances traversed by messengers in the highlands were made bearable by chewing the "cocada," a ball of coca leaves and lime, which produced feelings of euphoria and increased strength lasting about 40 minutes. The importance attached to coca in the everyday lives of the Incas is demonstrated by the many meanings of the word, "cocada." A "cocada" is not only a measurement of time (40 minutes), but is also a linear measure of the distance a man could walk while under the effects of coca leaves (between 2 and 3 kilometers).

The religious authorities who followed Pizarro into Peru viewed coca chewing as an idolatrous practice and sporadically launched vigorous campaigns to eliminate it. These efforts did not meet with much success, however, because the European political and economic rulers capitalized upon coca for the purposes of exploiting indigenous labor. Workers in the mines were paid with coca leaves, a currency which stimulated them to greater production and which helped them bear up under inadequate diets and unhygienic working and living conditions. Up to the present time, a majority of Indians in certain areas of the Andes continue to chew coca leaves in as routine a manner as Americans use tobacco, despite the recommendations of both the Peruvian government and of the United Nations that the practice be eliminated.

The leaves of the Inca's divine plant, Erythroxylon coca, contain from 0.5 to 1.5 percent cocaine by weight. Although the other components of the leaves no doubt contribute to the effect when chewed, it is believed that cocaine is the major active principle. It is also important to point out that, because the Indians use "cocaine" in such a diluted form and spread its effects out over a 40-minute period, they experience milder and less psychologically and physiologically destructive effects than do more sophisticated civilized users who have access to relatively pure cocaine.

The discovery and isolation of cocaine from coca leaves is usually attributed to a Viennese by the name of Niemann, who christened the compound in 1858. Mariana, an early researcher who produced many cocaine preparations for therapeutic applications, however, claims that Gardeke was the first to discover the drug, which he named "Erythroxyline."

For almost thirty years after its discovery, cocaine was viewed as little more than an exotic curiosity by the medical profession. Then, in 1884, Sigmund Freud obtained a supply of the drug to test its potential for weaning morphine addicts from their habits. Concurrently, he and a colleague by the name of Carl Koller began a series of physiological tests with cocaine. Shortly after the work began, however, Freud left on an extended visit to his fiancee and Koller went on to discover cocaine's important local anesthetic action.

The interest generated by Koller's discovery led a great many other physicians to experiment with cocaine in private practice and in hospitals and clinics. As was the case with morphine and other potent drugs of the late 19th century, cocaine soon became a prime ingredient in a plethora of "patent medicines" and home remedies. Preparations such as "Dr. Pemberton's

French Wine of Coca, the Ideal Tonic," and "Vin Mariani a la Coca du Perou," began appearing on drug and grocery store shelves across the nation.

A survey made by Crothers in 1902 revealed that only 3 to 8 percent of the total amount of cocaine sold in New York, Boston, Chicago, St. Louis, Philadelphia and other major cities went into the practice of medicine, dentistry and veterinary medicine. The presence of cocaine in soft drinks (such as "Coca Cola") and drug store "soda fountain" preparations continued until the passage of the Pure Food and Drug Laws of 1906. When the Harrison Narcotic Act of 1914 classed cocaine with morphine and other narcotics, the drug's recreational use was driven underground where it decreased gradually over the next thirty to forty years. Presently, though many street drug users have tried cocaine, its regular use commands a very small following. On the street, cocaine is regarded as a powerful, exotic drug, which all drug users should "try once." Because cocaine is very difficult to obtain, the few continuing users of the drug are to be found in major metropolitan centers, such as San Francisco, Chicago and New York, where the only regular channels of supply exist.

Pharmacology

Cocaine, chemically known as benzoylmethylecgonine, is a nitrogen-containing base which shares the three characteristics common to most other local anesthetics: (1) an aromatic residue, (2) an intermediate chain, and (3) an amino group. The most important pharmacological action of cocaine is its ability to directly block the generation and transmission of nerve impulses after local application. This blocking action, which is effective on all types of nerve fibers, is reversible: when the drug is absorbed into

the blood and carried away from the site of application, the neurons return almost immediately to a state of normal functioning. Cocaine's blocking effects on terminal sensory nerves can be attained with concentrations as low as 0.02 percent, although higher concentrations are required to block impulse conduction in nerve trunks or to anesthetize mucous membranes.

Cocaine's inhibition of both the generation and conduction of nerve impulses seems to be the result of the drug's effect on neuronal membranes, where it somehow interferes with ionic electrical exchange. It has been hypothesized that cocaine causes the pores in the neuron's membrane to contract so that potassium and sodium ions cannot enter and leave the cell. Without the transport of these ions across the membrane, the generation of an impulse is impossible.

Cocaine also causes vasoconstriction, constriction of blood vessels at the site of application. This constriction, which limits the quantity of blood passing around the site, thereby limits the amount of cocaine which can be absorbed and removed to the liver for detoxification. Once the drug reaches the liver, it is destroyed at a rate equal to about one lethal dose of cocaine per hour. This rate of destruction is considerably slower than that of other local anesthetics and for this reason cocaine is rarely given medically by injection.

The fatal human dose of cocaine is believed to be about 1,200 milligrams, but due to wide variations in individual susceptibility and to variations in reactions dependent upon different methods of administration, this dose should only be considered a rough estimate. Toxic effects from as little as 20 milligrams of cocaine have been reported; however, there are also reports of cases of individuals who have lived after total daily doses.

10,000 milligrams (in a series of frequent injections). Illicit users of cocaine usually employ about 500 milligrams of the drug.

The treatment of acute cocaine poisoning involves the intravenous administration of a short-acting barbiturate, the use of artificial respiration, and efforts to block the blood flow from the site of application. The primary objective should be the limitation of the amount of cocaine which enters the circulatory system. The convulsions which appear in the terminal stages of cocaine poisoning cannot be prevented with the usual anticonvulsant drugs (diphenylhydantoin, phenobarbital, acetazoleamide, etc.).

Studies with several animal species have demonstrated that no overt tolerance develops to the excitatory effects of cocaine. On the contrary, in many species (including man) the repeated use of cocaine at short intervals seems to induce a sensitivity to the effects of the drug. After continued administration, therefore, it takes less and less of the drug to elicit the same stimulating effects.

Pharmacological investigations have also failed to uncover any characteristic withdrawal syndrome after cessation of chronic cocaine administration. In a study with rats, for example, who were given 40 milligrams per kilogram over a prolonged period of time, performance on a discrimination task returned to a 100 percent normal level after the cocaine was withdrawn.

In view of the lack of tolerance and withdrawal effects displayed by cocaine, the drug cannot, in a strict sense, be termed addictive. However, a pattern of "psychological dependence" upon cocaine can develop which has a number of adverse consequences for the user.

Clinical Effects

Physiological

Besides its important effect of blocking neuronal transmission at the site of application, cocaine has a more general stimulating action on the central nervous system. This stimulating effect begins at the cortex and produces in man symptoms of excitation, restlessness, euphoria, and feelings of heightened physical and mental powers. The administration of small and moderate doses of cocaine to animals also causes stimulation of the cortex and a concomitant increase in motor activity. As the dose is increased, though, the lower centers of the brain are stimulated and tremors and convulsions frequently occur.

Cocaine's stimulation of the lower portion of the brain stem leads to an increased breathing rate, with individual breaths becoming more shallow. The drug may also stimulate the user's vomiting center in the brain.

Small doses of cocaine depress the heart rate, but moderate doses increase it. Large doses of the drug which reach the heart may cause immediate death as a result of cocaine's toxic action on the heart muscle. When the drug is first administered there is a rise in blood pressure, which is probably due to cocaine's vasoconstrictive action. Gradually, however, the blood pressure falls as the central stimulation produced by cocaine is followed by depression. This depressant action begins in the cortex and gradually proceeds to the lower centers. If the dose is high enough, the depression will continue until respiratory failure results in death.

Psychological and Behavioral

Cocaine produces a state of psychological excitation in man that is

extremely strong and which involves feelings of euphoria which are more pronounced than those seen with practically any other psychoactive agent, including heroin. Psychological depression, however, follows this state in a rather short period of time (30 minutes). This depression is in such marked contrast to the previous pleasurable sensations induced by intravenous use of cocaine, that users may be motivated to repeat the dose immediately in order to recapture the original state. A cycle may then develop, with the user injecting the drug at short intervals (as little as 10 minutes apart) in an attempt to maintain a constant euphoric state. The repeated administration of cocaine tends to increase the severity of excitatory symptoms. Users may, therefore, become so psychologically excited and agitated that they succumb to an intense anxiety state with gross paranoid features. In this state hallucinations are not uncommon and abnormal sensations induced by cocaine in the peripheral nerves may convince the hyperexcited user that animals are burrowing under his skin. Several cases of individuals who injured themselves in attempts to "dig out the cocaine bugs" have been reported. The behavior of individuals in a hyperexcited, toxic cocaine state is often irrational and violent, much more so than in the case of the heroin addict.

The effects of long-term cocaine use on psychological functions have not been the subject of much controlled study. The psychological performance of long-term chewers and non-users of coca leaves, however, was compared by one group of researchers in a hospital setting. Three groups of subjects were used in this study: (1) users who had consumed at least 200 grams of coca leaves per week for at least 10 years, (2) abstainers, who were equivalent to the users but discontinued their coca use for the period of the study,

and, (3) non-users, who had never, or only infrequently chewed coca leaves. The abstainers showed no overt discomfort during the study; they displayed a normal appetite and had no trouble going to sleep. They did, however, perform somewhat poorer on tests of I.Q., memory, attention and learning than did the non-users or the continuing users. The non-users consistently scored better on most of the tests, with the continuing users not far behind. This suggests that some difficulties may be experienced by long-term coca chewers upon giving up the practice.

There is some question, however, as to whether the results of this study support the conclusion that withdrawing from chronic coca use causes losses in mental performance, and that long-term use itself leads to psychological underfunctioning. The group of non-user controls used in the study contained individuals who were more literate than did the user and abstainer groups. Literate individuals can be expected to outperform non-literates on the sorts of tests used in this study. The fact that long-term coca use is associated with inferior nutritional and hygienic states was another variable not taken into consideration. At best, it can be concluded that long-term coca chewing may be associated with sub-standard mental functioning, and not that coca use causes any such decrements.

Subjective Effects and Patterns of Use

The subjective stimulant effects of cocaine resemble those of the amphetamines, but are somewhat more intense and have a shorter duration or action. One of the earliest subjective descriptions of cocaine's effects comes from Dr. Mantegazza, one of the first researchers to conduct clinical trials with the drug:

> Borne on the wings of two coca leaves, I flew about in the spaces of 77,438 worlds, one more splendid than another. I prefer a life of ten years with coca to one of a hundred thousand without it. It seemed to me that I was separated from the whole world, and I beheld the strangest images, most beautiful in color and in form than can be imagined.

In more contemporary terms, "Iceberg Slim" described his first cocaine experience in his book, The Story of My Life (1967):

> I saw the blood-streaked liquid draining into me. It was like a ton of nitro exploding inside me. My ticker went berserk. I could feel it clawing up my throat. It was like I had a million "swipes" in every pore from head to toe. It was like they were all popping off together in a nerve-shredding climax.
>
> I was quivering like a joker in the hot seat at the first jolt. I tried to open my talc-dry mouth. I couldn't. I was paralyzed. I could feel a hot ball of puke racing up from my careening guts. I saw the green stinking rope arch into the black mouth of the waste basket . . .
>
> I felt like the top of my skull had been chrushed in. It was like I had been blown apart and all that was left were my eyes. Then tiny prickly feet of ecstasy started dancing through me. I heard melodious bells tolling softly inside my skull.
>
> I looked down at my hands and thighs. A thrill shot through me. Surely they were the most beautiful in the Universe. I felt a superman's surge of power.

The use of cocaine alone does not appear to command much of a following among street users. In order to avoid the violent rush of excitation precipitating a tremendous depression (which has been aptly described by many users as "the worst crash in the world"), most devotees take the drug in combination with a longer-lasting euphoriant, such as heroin. Mixtures of cocaine and heroin are sold on the street as "speedballs," and, according to one user, bring on the following reaction:

> The reason for a speed is you get this tremendous girl (cocaine) kick that lasts only about one-half hour, and after it sort of starts dying off you have this almost buzzing sensations in all of your body and everything. But it becomes definitely sensuous, you know, all of a

> sudden and then after that it is just beginning to wear off, then wham, it's just like you made the boy (heroin) then. It comes on with this flash and everything. It's as though it holds off, you know, until the girl can operate.

It should be mentioned at this point that the toxic-psychotic state which develops with many compulsive cocaine users is not a fundamental part of all forms of cocaine use and abuse. While many individuals regularly succumb to states of agitation and paranoia, others are able to use cocaine for months or years without the appearance of any serious adverse effects. Similarly, the some 2,000,000 male adult Peruvian Indians who regularly chew coca leaves only infrequently experience any gross adverse reactions.

Legal Aspects

Under the provisions of the "Comprehensive Drug Abuse Prevention and Control Act of 1970" (Public Law 91-513), cocaine is classed as a schedule II drug along with opium, minor opiates, injectable methamphetamine and other forms of amphetamine.

Under Federal law, simple possession of cocaine is punishable by a prison sentence of up to one year and a fine of up to $1,000. Manufacture, distribution or possession with intent to distribute cocaine is punishable by imprisonment of not more than 5 years and/or a fine up to $15,000. Upon conviction for a second offense for manufacture, distribution or possession with intent to distribute, imprisonment may extend to not more than 10 years and the fine may be raised to not more than $30,000. Any person over the age of 18 who distributes cocaine to an individual under twenty-one years of age is liable to imprisonment of no more than 10 years and a fine of no more than $30,000. Subsequent offenses of selling to minors are punishable by prison terms of no more than 20 years and fines of no more than $60,000.

Authoritative Opinions

The use of cocaine and coca leaves over the past few centuries has prompted a great deal of controversey. As can be seen from the following sample of authoritative opinions, the oral use of coca leaves produces effects which are of a different order of magnitude than those seen with intravenous injection of pure cocaine:

> I discovered in myself, and in other observers who were capable of judging such things . . . that . . . even repeated doses of coca produce no compulsive desire to use the stimulant further; on the contrary, one feels a certain unmotivated aversion to the substance.
>
> --SIGMUND FREUD

> In view of the fact that many of these highlanders, who have used coca leaves for years, abandon the practice when transferred to a lower altitude, it does not seem appropriate to call this use of cocaine an addiction. This chronic use, without overwhelming emotional involvement, again attests to the general principle that the repeated use of the drug per se does not produce addiction, but that addiction arises when persons with emotional difficulties encounter drugs which have ameliorative effects for their particular emotional problems.
>
> --JEROME H. JAFFE

> Given the hunger, cold, and pain of Alti Plano life, given the awful taste of frozen potatoes, which are the dietary mainstay, given, in high altitudes, the fatigue of workers whose average age at death is between thirty and thirty-five, it is not surprising that a feeling-suppressant, analgesic, and stimulating drug (cocaine) is required."
>
> --RICHARD H. BLUM

> During recent years I have seen among men of science frightful symptoms due to the craving for cocaine. Those who believe they can enter the temple of happiness through this gate of pleasure purchase their momentary delights at the cost of body and soul. They speedily pass through the gate of unhappiness into the night of the abyss. The pursuit of science is not enough to prevent folly.
>
> --LEWIS LEWIN

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The National Clearinghouse for Drug Abuse Information, operated by the National Institute of Mental Health on behalf of the Special Action Office for Drug Abuse Prevention and the Federal agencies engaged in drug abuse education programs, is the focal point for Federal information on drug abuse. These Federal agencies are the Department of Justice, Bureau of Narcotics and Dangerous Drugs; Department of Health, Education, and Welfare; Office of Economic Opportunity; and the Department of Defense. The Clearinghouse distributes publications and refers specialized and technical inquiries to Federal, State, local, and private information resources. Inquiries should be directed to the National Clearinghouse for Drug Abuse Information, 5600 Fishers Lane, Rockville, Maryland 20852.

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